

the wound can be well protected with a dried milk dressing.\* Dried milk is sprinkled thickly on the skin around the drainage tubes, a layer of gauze placed over this and milk again sprinkled over the gauze; the usual dressings are then applied. Dried milk, with its high concentration of fat, protein, and carbohydrate, has the advantage of neutralizing all of the ferments of the pancreas and thus aids in protecting the skin.

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CHARLES A. DUKES, M. D. (426 Seventeenth Street, Oakland).—Pancreatitis is a disease which has been frequently overlooked not only by the surgeon but by the diagnostician, especially the type of cases which have been reviewed under the head of subacute pancreatitis and those which follow operation on the biliary tract.

In the treatment of an acute condition of the abdomen where the diagnosis or operation seems somewhat hazy, where the appendix is not sufficient to account for the acute condition and the gall bladder is not sufficiently involved to lead one to suspect this as a cause of the condition, the surgeon certainly is negligent who does not expose the pancreas and definitely determine its condition.

It has seemed to me at times that, in the severe conditions which accompany acute pancreatitis, we are prone to use a type of anesthetic that does not give complete relaxation and the best opportunity for exploration of the abdomen. In these acute conditions there is a natural tendency to hurry the investigation.

I am very much impressed with the necessity for thorough drainage in these cases. I think this has been excellently shown in a paper by Olds, read before this section last year. There is no doubt in my mind that proper drainage of these cases will further reduce the mortality rate.

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DOCTOR BREYER (Closing).—Because of lack of time it was not possible for me to take up the symptomatology of pancreatitis. I am very glad that the discussers have emphasized the difficulty of making an accurate diagnosis. We shall be glad to try on our next case the dried milk as a dressing for intestinal fistula suggested by Dr. Clarence E. Rees.

### POSTOPERATIVE MASSIVE ATELECTASIS†

A DISCUSSION OF ITS ETIOLOGY, PREVENTION AND TREATMENT, WITH REPORT OF CASES

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DISCUSSION by Frederick Leet Reichert, M. D., San Francisco.

ALTHOUGH the clinical aspects of postoperative massive collapse have become thoroughly familiar to surgeons through the recent reports of Scrimger,<sup>1</sup> Scott,<sup>2,3,4</sup> Churchill,<sup>5</sup> Jackson,<sup>6</sup> Lee,<sup>7</sup> Sante,<sup>8</sup> et al., the etiology of this most interesting phenomenon remains sufficiently obscure to warrant the detailed presentation of individual experiences which provide important and possibly illuminating evidence as to the mechanism of its production.

#### PATHOLOGY

In his original definition of postoperative atelectasis William Pasteur emphasized "the

\* Rees, Clarence E.: Fried Milk as a Dressing for Intestinal Fistula, *California and West. Medicine*, 30:419, 1929.

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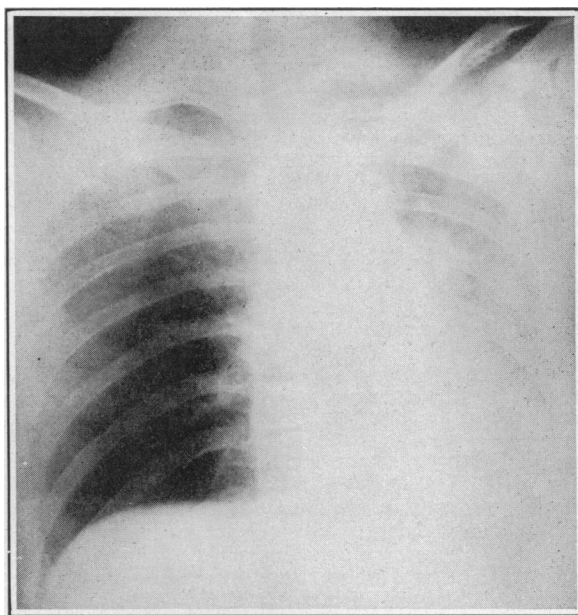


Fig. 1.—Massive atelectasis of the left lung with displacement of the mediastinum and heart to the left fourteen hours after appendectomy. Case 2.

failure of inspiratory power" as being responsible for the sudden deflation of large areas of lung tissue, a deflation which he thought occurred in the absence of any signs of obstruction of the airways. The failure in inspiratory power he attributed to the loss of the mobility of the diaphragm, either by direct paralysis or by reflex inhibition from acute inflammation. Briscoe attributes the deflation of the lung partly to the normal consequence of diminished breathing incident to a prolonged supine posture, incident to a severe illness, and partly to the alterations in the action of the diaphragm and of the muscles accessory to the diaphragm produced by inflammation of the muscles or of the pleural membrane covering them.

Most modern authors consider that bronchial obstruction associated with a weakened or diminished respiratory force plays the important part in the development of atelectasis. The site of this bronchial obstruction was thought by Elliott and Dingley<sup>9</sup> and later by Scott,<sup>2</sup> to be located in the bronchioles and peripheral respiratory passages, whereas Lee and Jackson<sup>6</sup> consider plugs of thick, tenacious mucus in the larger bronchi, observable and removable by bronchoscope, to be responsible for the obstruction.

To explain the hypothetical obstruction in the bronchioles, Scott suggests that the fundamental condition which initiates massive atelectasis is a nervous reflex, probably vasomotor, which causes a bilateral, partial obstruction in the peripheral respiratory passages, and that posture and tenacious sputum are secondary factors which make this obstruction complete on one side in advance of the other with a subsequent unilateral absorption of air to complete the picture of

massive collapse. In this he is sustained by Sante<sup>8</sup> who suggests that some injury or insult in the region of the vagus distribution produces a reflex constricting action on the bronchioles, permitting their temporary collapse, with an accompanying absorption of the alveolar air beyond the collapsed bronchioles.

In recent reports there has been a gradual accumulation of concrete evidence in favor of the belief that central bronchial obstruction plays the important part in the production of massive atelectasis.

1. There is a striking similarity between this condition and the collapse accompanying the occlusion of primary bronchi by intrabronchial neoplasms.

2. The experiences of Lee and his associates demonstrate the feasibility of prompt refilling of an atelectatic lung by the bronchoscopic removal of mucous plugs from the large bronchi.

3. The condition can be accurately duplicated experimentally by the introduction of a plug of thick sputum into the main bronchus of a dog in whom the cough reflex has been abolished by sodium barbiturate administered intraperitoneally (Lee<sup>7</sup>). Air in the alveoli was gradually absorbed beyond the obstruction and massive collapse ensued. Similarly partial collapse of one lung has been produced in our laboratory by bronchial plugging of sea sponges.

Additional evidence that the plugging of the larger bronchi by thick sputum is responsible for the development of acute atelectasis was furnished by the two following clinical cases. One of them we believe to be unique in its manifestations.

#### REPORT OF CASES

CASE 1.—A man of forty-five with poor, carious teeth, badly infected gums and a purulent pharyngeal discharge was operated on for carcinoma of the pylorus, and a Polya resection performed under gas

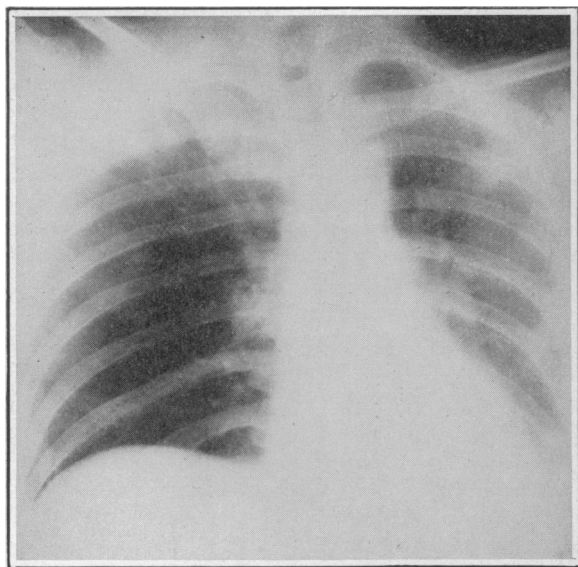


Fig. 2.—Roentgenogram demonstrating immediate improvement after turning patient on right side followed by prompt expectoration of a thick mass of sputum. Case 2.

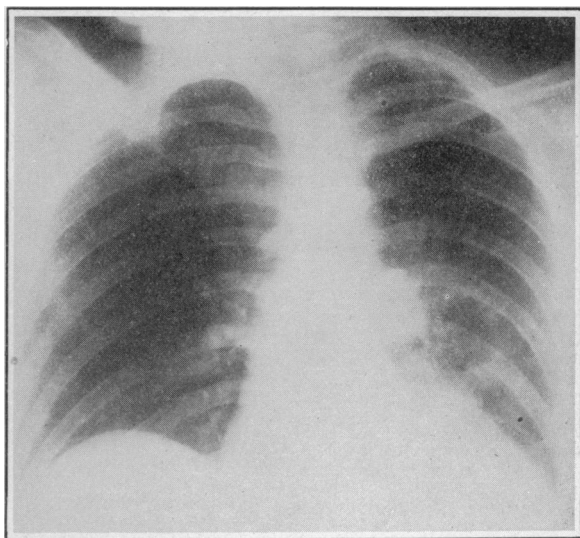


Fig. 3.—Roentgenogram demonstrating a fairly normal appearance of lung immediately following the expectoration of a mass of sputum which had produced a recurring atelectasis. Picture taken twenty-four hours after Fig. 2.

and ether anesthesia. Fourteen hours after his return to the ward the nurse noted on the bedside chart "The patient seems to have considerable mucus in throat and is unable to cough it up."

Twelve hours after this note was made it was observed that the pulse rate was 132, respirations 32, temperature 102 degrees Fahrenheit. Examination revealed marked diminution of respiratory movements on the right with retraction of the chest wall and complete displacement of the heart to the right side. An immediate x-ray examination (Fig. 1) showed the typical appearance of a massive collapse. The next morning we returned to find a greatly changed patient with a temperature of 100 degrees Fahrenheit, pulse 102, and respirations 24, and with complete disappearance of the respiratory distress and physical signs previously observed. An immediate roentgenogram showed practically complete disappearance of the atelectasis. The patient informed us that during the night he had spat up about a half cupful of thick yellowish sputum and that this was followed by prompt relief of all subjective distress and dyspnea. An uneventful recovery followed.

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CASE 2.—A young sophomore at college, eighteen years old, was operated upon for acute gangrenous appendicitis and localized abscess, following symptoms of three days' duration. The appendix was removed through a McBurney incision under gas anesthesia and the wound drained. Accompanying the abdominal symptoms there had developed a cough with some purulent sputum. The lungs were clear.

Fourteen hours after the operation the patient was quite ill, coughing and raising small amounts of thick, yellowish sputum. The abdomen was markedly improved as compared to its condition the day before. The chest, however, showed a striking picture: The left side was retracted and moved almost not at all on respiration. The heart was displaced markedly to the left, the right border being demonstrable to the left of the sternum. In its upper half, the left chest was flat to percussion, and no breath sounds were audible, only a few moist râles. An immediate roentgenogram revealed a typical massive collapse. (Fig. 1.) Under the fluoroscope the patient was then rolled over on his good side (Sante<sup>8</sup>) and an immediate improvement in the aeration of the left lung was observed under the fluoroscope with a marked change

in the physical signs. (Fig. 2.) The patient, who was an intelligent college student, volunteered the information that with the change in position he noted subjectively a *feeling as though a whistling had occurred in his left chest, and that this whistling seemed to start in the region of the sternum and to travel toward the left clavicle*. A few minutes after the improvement was noted the patient coughed up a half ounce of thick purulent material.

Twenty-four hours later the patient was again observed and again the typical appearance of a massive collapse was present with physical signs identical with those present before the expectoration of mucus on the previous morning. On this occasion loud rhonchi could be heard over the entire left chest. In order to examine the patient posteriorly more carefully he was asked to roll slightly to the right side. To our astonishment and chagrin, the patient began to cough and to spit up a large amount of greenish yellow mucus, some of it quite firm, being almost a cast of the bronchus. Again, as before, the patient noted the whistling within his chest proceeding from the sternum to the clavicle. There was an immediate change in the physical signs and appearance of the patient, and there remained no physical nor radiologic evidence of the massive collapse. (Fig. 3.)

Improvement continued satisfactorily until three days later, when the patient again presented the physical signs of a massive collapse with rapid and difficult breathing. It was accompanied by bubbling respirations, and loud noises were heard throughout his left chest. A fluoroscopic examination was requested, but in transferring the patient to the fluoroscopic table he was rolled onto the unaffected or right side with prompt relief from his difficult and rapid breathing. For the third time the whistling sensation running from the sternum to the clavicle was experienced by the patient followed by the expectoration of considerable sputum. There can be little doubt as to the interpretation of this phenomenon. With the displacement of a large plug of mucus from the main bronchi, the collapsed channels and alveoli of the atelectatic lung were suddenly filled with a rush of air through the bronchi, and one cannot escape the conclusion that the bronchial obstruction of a massive collapse lies not in the peripheral respiratory passages but in the central or hilar bronchi. The observation indicates also that there is considerable negative pressure within the collapsed lung which acts as a constant suction in holding the thick bronchial secretion in place once the collapse has occurred, increasing the difficulty of the removal of this secretion by the ordinary act of coughing.

#### SEQUENCE OF EVENTS IN ACUTE ATELECTASIS

Our conception of the sequence of events leading to the completed picture of acute atelectasis is as follows:

1. Accumulation of a mucopurulent tenacious exudate in the hilar bronchi of one side. The amount and character of this bronchial exudate is undoubtedly influenced by the presence or absence of a respiratory infection before operation and by the reaction of the bronchial mucosa to the type of anesthesia administered. The factors determining the side upon which such accumulation occurs are: (a) Posture on the operating table, Scott<sup>3</sup> and Jackson<sup>6</sup> have suggested that the dependent side is the one on which the collapse develops. (b) Compression of part of the thorax by lying on one side or by resting on a sandbag or elevations such as are employed in operations on the kidney. Such compressions result in incomplete aëration of the compressed lobe or lung

on one side, permitting the accumulation of mucus in the bronchi. (c) A prolonged recumbency in one position after operation, any movement being resisted by the patient because of pain.

The prompt appearance of acute collapse within the first twenty-four hours after operation in more than half of the reported cases suggests that this mucus began to collect during the period of anesthesia and that its accumulation in the larger bronchi was determined and assisted both by posture and by the incomplete aëration of part of the lung and by the absence of coughing during the anesthesia.

2. After operation the voluntary arrest of movement of all the respiratory muscles because of the pain associated with deeper respirations favors the further accumulation of mucus in the bronchi, the site of this accumulation being determined again by posture and by the previous compression of the chest.

3. Through fear of pain the patient is unwilling to contract the traumatized abdominal muscles and to make the forced expiratory effort in the act of coughing necessary to dislodge the accumulating mucus. This, of course, is more pronounced in the sensitive and nervous patient whom Scott thought particularly susceptible to his vasomotor reflex responsible for the initiation of the collapse, but anyone who has experienced an abdominal operation will realize the reality of the pain accompanying breathing and coughing in the first few days following a laparotomy.

4. The complete blocking of the main bronchus or bronchi to one lobe or to lobes causes the absorption of air in the lung beyond the obstruction with shrinking of the affected lung and distention of the other lung. Displacement of the mediastinum and heart is the result of these last two factors. The completeness or incompleteness of the blocking of the bronchus explains the diverse physical signs encountered, particularly with reference to the loud râles and rhonchi occasionally heard. An incompletely plugged primary bronchus accompanied by complete blocking of the main bronchus to one of the lobes only will permit air to bubble back and forth into the expanding lobe, whereas almost complete silence will be present over the area of the lobe to which the completely plugged bronchus leads. In many instances the signs accompanying the atelectasis are much more pronounced over one or the other lobe of the affected side and, as pointed out by Lee<sup>7</sup> and Churchill,<sup>8</sup> the phenomenon of atelectasis may affect the lung in varying degrees, involving in different cases parts of a lobe, one lobe or the whole lung on one side. The partial involvement of a lobe is no doubt frequently overlooked due to the meagerness of the physical signs accompanying the atelectasis.

Although there is a tendency to minimize the serious effects of this postoperative complication, recent work<sup>10</sup> suggests strongly that the more serious complication of pneumonia may have its

origin in areas of atelectasis. Our every effort should, therefore, be directed toward its prevention.

#### MEASURES TO PREVENT ATELECTASIS

Bearing in mind the probable sequence of events leading to its occurrence, let us consider the measures, in the order of their application, which may aid in avoiding the development of atelectasis.

1. The formation of thick, tenacious mucus, which is so frequently observed as the probable cause of a massive collapse, may be favored by a too large dose of atropin before operation. When a patient gives preoperative evidence of a purulent bronchitis it may be better to avoid giving any atropin at all. A more abundant but thin bronchial secretion is preferable to a thick, tenacious secretion.

2. Large preoperative doses of morphia should be avoided lest the morphia aid in producing shallow breathing and complete abolition of the coughing reflex for a prolonged period after anesthesia has ceased. When preoperative evidence exists as to the presence of a bronchial secretion, due to a chronic respiratory infection, it would be preferable to administer none or only small preanesthetic doses of morphia. It is evident that the anesthetist should be familiar with the exact condition of the patient before giving the preanesthetic order of atropin and morphia. Similarly too frequent and too large doses of morphia should be avoided after operation for the same reasons. It is our practice to use rectal instillations of large doses, forty to eighty grains, of sodium bromid, in tap water, supplemented by small doses of morphia to control postoperative pain.

3. All areas in the lung which may have remained "silent" or subject to minimum aëration during the operation, due to posture and compression, should be well expanded through hyperventilation induced by carbon dioxid saturation, by rebreathing or by breathing a mixture of carbon dioxid and oxygen at the end of the operation, as advocated by Scott and Cutler.<sup>4</sup> Incipient plugging of a bronchus may well be cleared by this procedure. Scott advocates "the use of gas from a tank of 30 per cent carbon dioxid and 70 per cent oxygen which is delivered undiluted to the mask, the anesthetist varying the amount of carbon dioxid given by allowing the admixture of air around the mask, and by the interval the latter is held in position. The whole purpose of the procedure is to hyperventilate fairly vigorously but not sufficiently to tire the patient or to raise the blood pressure excessively. After the patient begins to breathe deeply and at a slightly increased rate, the mask is removed or lifted and the hyperventilation diminishes. Usually several such waves of increased depth of respiration are produced in this manner over a period of from five to ten minutes. For a moderately long ether anesthesia this does not suffice to deëtherize the

patient completely to the point of consciousness, though it usually improves the color and the pulse volume. The purpose of this routine hyperventilation is not primarily that of deëtherization, but the prophylaxis of massive atelectasis. The precaution is always taken that hyperventilation is not carried to the extent of tiring the patient. Infants, persons with pulmonary disease, and cachectic patients are the only ones not given hyperventilation."

4. Upon the return of the patient to his room the following regimen is undertaken:

(a) Semi-Fowler's position is usually practiced, particularly when the patient is lying on his back.

(b) The position of the patient is changed at hourly intervals by rolling slightly to either side, maintaining the position by pillows under the back.

(c) The patient is instructed to cough up any mucus which may be heard collecting in the bronchi, and is assisted in this act of coughing by pressure over the abdominal dressing, giving added support to the abdominal muscles.

(d) The patient is encouraged to breathe deeply at intervals, regular breathing exercises being instituted by the nurse and by the doctor when the patient is conscious.

(e) After the first twenty-four hours the patient is rolled completely over on either side several times daily in order to assist in dislodging collecting mucus as suggested by Sante.

These measures may be utilized to prevent the appearance of acute atelectasis and undoubtedly serve also in the prevention of so-called hypostatic pneumonia, which may have its origin in atelectatic areas. Once the condition of atelectasis has arisen, the patient is treated by rolling him to the good side, as advocated by Sante. When thick, tenacious sputum is present, potassium iodid or ammonium chlorid may be administered to thin and loosen it.

Bronchoscopy, as advocated by Lee and Jackson, has not been utilized by us in the few instances seen. It is a serious procedure in a patient just recovering from the effects of a major operation twenty-four hours previously, and the efficacy of the method of Sante was so well demonstrated in the second case reported by us that it is the first procedure to be undertaken. In experienced hands bronchoscopy may be employed if Sante's procedure fails to dislodge the obstruction, but it cannot be recommended as a general therapeutic procedure.

#### SUMMARY

Evidence that acute atelectasis is due to a central bronchial obstruction is furnished by the experience with an example of this postoperative complication on the left side in which a subjective feeling of "whistling" occurred, proceeding from under the sternum and traveling toward the left clavicle, coincident with the coughing up of a

large amount of thick sputum and followed by the complete disappearance of all signs and symptoms.

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#### DISCUSSION

FREDERICK LEET REICHERT, M.D. (Stanford Hospital, San Francisco).—The two excellent case illustrations in Doctor Mathes' and Doctor Holman's paper offer a beautiful demonstration of the importance of careful and scientific observation in determining the etiology of postoperative massive collapse. Such detailed record of cases facilitates accurate deductions and leads to clarification of the subject.

During the past four years with the further knowledge of the etiology of pulmonary atelectasis, the anesthetist has nearly forgotten his great fear, that of "anesthetic pneumonia." Through his efforts during and at the end of the operation as well as by the improved postoperative care of the patient, this distressing complication is disappearing. Formerly this so-called anesthetic pneumonia was in many cases either massive atelectasis or its offspring, hypostatic pneumonia.

The anesthetist plays an important rôle in its prevention as the authors have indicated. He should warn the operator of its possible development in the individual case from his observations of the duration of the anesthesia, or the presence of mucus, or the position of the patient on the operating table. Often after light anesthesia and before the operative pains are felt by the patient, the anesthetist can prevail upon the patient to expectorate and to cough up a potential mucous plug.

This condition may develop following operative procedures elsewhere than in the abdomen, as the following case will illustrate. After two left craniotomies on a child of seven years under ether anesthesia for the two-stage removal of a brain tumor, a right-sided pulmonary atelectasis developed, and each time, by turning the child onto the left side, tenacious bronchial plugs were coughed out. The long operation

with the patient lying on the right side, plus considerable mucus from ether irritation and the prolonged right-sided position in bed to prevent pressure on the operative wound, were all inducive to the development of this complication. The expediency of just rolling the child onto the good side removed the plug with prompt improvement of pulse, respiration and temperature.

### CERTAIN OPERATIVE PROCEDURES EMPLOYED IN OPHTHALMOLOGY\*

#### REPORT OF CASES

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WHEN the invitation to present a paper before this section was extended to me my first impulse was to acknowledge my appreciation of the honor and then decline. After discussing the matter it seemed permissible to depart somewhat from the stereotyped procedure of presenting a formal paper on some one particular subject, and instead to give my own personal experiences in dealing with the different surgical conditions which one meets in the daily practice of ophthalmology.

#### CATARACT OPERATIONS

Because of its importance and the position which it occupies in the list of diseases amenable to operation, cataract operation will be discussed first. Let me say at once that I do not practice the intracapsular operation except in certain selected cases, and then only in such manner as to safeguard the integrity of the eye to the utmost.

Inasmuch as all of us are interested in knowing how other surgeons operate, and how best to improve our own technique, it seemed to me that by describing my own methods of operating I might be able to help someone and that the general informal discussion which I hope will follow will bring out much that will be mutually beneficial. We are, or should be, eclectic in developing our technique.

*Preparation.*—In preparing the patient for operation I try to break into the routine of his life as little as possible; at the same time I speak of the operation as though it were of no particular moment. Of course the family have been told that it is a procedure requiring more than ordinary skill, judgment, and experience, and even under the very best of conditions may be unsuccessful. I always operate in the late afternoon unless there are specific reasons to do otherwise. There are several good reasons why this has proven satisfactory for me and my patients. The first six hours after the operation are the most important, and the patient during this time should be kept as quiet and free from annoyance as possible. Not infrequently the patient falls asleep after being placed in bed and does not awake for six or seven hours. Then, too, the necessary noises and disturbances incident upon hospital activity are beginning to abate by 4 o'clock in the

\* Read before the Ophthalmological Section of the Utah State Medical Association, June 30, 1928.